MARKED SPECIFICATION

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IMAGE DISPLAYING METHOD, GAME SYSTEM AND COMPUTER READABLE STORAGE MEDIUM STORING IMAGE DISPLAYING PROGRAM

BACKGROUND OF THE INVENTION

~~Field of the Invention~~

The present invention relates to an image displaying method in a game system and the like, ~~especially belongs~~ and more particularly to a technical field of an image displaying method for constituting an image by processing image data for each [[flame]] frame and outputting [[them]] the frames to a display device.

~~Description of the Related Art~~

Recently, the quality of a game picture has been improved with the improvement of the processing performance of a game machine. In the conventional home use game system, the game picture is constituted by outputting image data to be displayed on the monitor of the NTSC television

system by each [[flame]] frame. In such a game system, 60 ~~flames~~ frames of [[flame]] frame image data are generated in one second corresponding to an NTSC interlace scanning.

It is desirable to improve a resolution by increasing pixel number constituting [[flame]] frame image data for the improvement of the game picture. On the other hand, it is necessary to control the total number of pixels of the [[flame]] frame image data because there is certain amount of restriction on memory size for storing [[flame]] frame image data and image processing capacity. Therefor, there exists a conventional method to substantially double the resolution by, for example, shifting a position of an even number [[flame]] frame from that of an odd number [[flame]] frame in vertical direction by half size of one pixel and outputting [[flame]] frame image data by turns. Thus, it is possible to display a high quality game picture ~~with control~~ while controlling the data size and processing amount in image processing [[and]].

However, even when the above described method is applied, the image processing must be conducted 60 times per one second, resulting in a seriously heavy load of processing. On the other hand, there will be a heavy load when other processing, for example, a calculation of three-dimensional expression is conducted in synchronism with image processing of each [[flame]] frame. In some ~~situation~~ situations of the game, it ~~possibly happens~~ is possible that all of

the processing can not be finished within a [[flame]] frame. As a result, the synchronism for each [[flame]] frame can not be attained and a disorder appears on the game picture.

SUMMARY OF THE INVENTION

The present invention is made to solve these problems. It is an object of the present invention to provide [[with]] an image display method capable of displaying a high-quality picture without ~~making any~~ disorder [[on]] of the picture, even when the processing load increases.

In order to solve the above problems, according to the first embodiment of the present invention, there is provided an image displaying method for displaying an image by outputting image data by each [[flame]] frame to a display device, wherein it is possible to [[set]] alternatively set a first display mode which outputs image data to the display device with a different pixel arrangement for each [[flame]] frame and a second display mode which outputs image data to the display device with an identical pixel arrangement for each [[flame]] frame, judging a scale of a processing load performed within one [[flame]] frame, and setting the first display mode when the load is judged to be light or setting the second display mode when the load is judged to be heavy.

The second embodiment of the present invention is a game system displaying an image by outputting image data to a display device for each [[flame]] frame, comprising a display mode setting device for ~~setting~~ alternatively setting a first display mode outputting image data to the display device with a different pixel arrangement for each [[flame]] frame and a second display mode outputting image data to the display device with an identical pixel arrangement for each [[flame]] frame, wherein the display mode setting device judges a scale of processing load performed within one [[flame]] frame, and sets the first display mode when the load is judged to be light, or sets second display mode when the load is judged to be heavy.

The third embodiment of the present invention is a computer readable storage medium storing an image display program formed so as to make a computer, performing an image display processing and displays ~~to display~~ an image by outputting image data to a display device by each [[flame]] frame, perform the functions of ~~function as~~; being able to set alternatively a first display mode which outputs image data to the display device with a different pixel arrangement for each [[flame]] frame and a second display mode which outputs image data to the display device with an identical pixel arrangement for each [[flame]] frame, and judging a processing load performed within one [[flame]]

frame and setting the first display mode when the load is judged to be light or setting the second display mode when the load is judged to be heavy.

According to these embodiments, an image is displayed by setting the first display mode when the load is light and by setting the second display mode when the load is heavy during outputting the image data to the display device by each [[flame]] frame. Accordingly, the resolution is improved artificially as a different pixel arrangement for each [[flame]] frame in a normal situation. On the other hand, the processing load is lightened if the processing is too busy to be performed. ~~Therefor~~ Therefore, the disorder of picture quality is prevented by arranging identical pixel for each [[flame]] frame and an image is displayed with a well-balanced adjustment between the quantity of processing and the quality of the picture.

The fourth embodiment of the present invention is an image displaying method ~~characterized by that~~ wherein the first display mode constitutes image data by arranging pixel data at different pixel positions each other for an odd number [[flame]] frame and an even number [[flame]] frame.

The fifth embodiment of the present invention is a game system ~~characterized by that~~ wherein the display mode setting device makes the first display mode constitute image data by arranging pixel data at different pixel

positions each other for an odd number [[flame]] frame and an even number [[flame]] frame.

The sixth embodiment of the present invention is a computer readable storage medium storing an image displaying program ~~according to claim 10 in the invention according to claim 9 is characterized by that~~ wherein the first display mode constitutes image data by arranging pixel data at different pixel positions each other for an odd number [[flame]] frame and an even number [[flame]] frame.

According to these embodiments, as the processing load is judged by comparing the processing time with the predetermined reference value, judgement for switching the first display mode to the second display mode is performed accurately.

The seventh embodiment of the present invention is an image display method ~~characterized by that~~ wherein the switching operation to the first display mode is performed if the processing time is continuously less than the reference value during predetermined number of ~~flames~~ frame in the case where the second display mode is set.

The eighth embodiment of the present invention is a game system ~~characterized by that~~ wherein the display mode setting device sets a switching to the first display mode when the processing time is continuously less than the

reference value during predetermined number of ~~flames~~ frames in the case where the second display mode is set.

The ninth embodiment of the present invention is a computer readable storage medium storing an image displaying program ~~characterized by that~~ wherein the program is formed so as to make the computer switch to the first display mode when the processing time is continuously less than the reference value during predetermined number of ~~flames~~ frames in the case where said second display mode is set.

According to these embodiments, [[a]] the switching operation is not immediately conducted even when the processing load is lightened during the setting to the second display mode, and the switching operation is conducted after the consecutive situation where the processing load is light[[,]]. Consequently, a steady switching operation can be realized.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram showing brief constitution of the game system of one embodiment of the invention;

FIG. 2 is a diagram showing a data structure of the [[flame]] frame picture used in the first display mode; and

FIG. 3 is a flowchart showing a display processing in the embodiment of the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

There will be explained hereinafter a preferred embodiment of the invention with referring to the drawings. Here, the embodiment in which the present invention is applied to a conventional home-use game system will be explained.

FIG. 1 is a block diagram showing a brief constitution of the game system of this embodiment. The game system shown in FIG.1 comprises a CPU 11, a ROM 12, a RAM 13, an interface 14, a controller 15, an external memory 16, a paint processing portion 17, a [[flame]] frame buffer 18, a monitor 19, a DVD-ROM drive 20, a sound processing portion 21 and a speaker 22. The system makes the required game be operated by setting the DVD-ROM 10 storing a game program and game data on the DVD-ROM drive 20.

In FIG. 1, CPU 11 controls the operation of the whole game system and gives/receives control signals and data by being connected to each constitutional element. The ROM 12 and the RAM 13 are used as storing devices. The operating system program and various kinds of data required for the operation

control of the whole game system are stored in the ROM 12. A memory area is provided on the RAM 13 for tentatively storing game program readout from the DVD-ROM 10, or data necessary for the game proceeding.

The controller 15 connected via the interface 14 functions as an operation device for the player's operation during the game. The controller 15 comprises operation members such as a cross key 15a for inputting vertical and horizontal direction and a push button key 15b. Signals corresponding to the operation status of these operation members are output to the CPU 11. Further, external memory 16 is connected attachably to/ detachably from CPU 11 via an interface 14 and is used for rewritably storing the data which indicates the progress of the game. The player of the game can record a desired data on the external memory 16 by commanding it with the controller 15 as required.

The DVD-ROM 10 is a storage medium storing program for executing the game and various kind of collateral data such as image data and sound data relating to the game. The DVD-ROM drive 20 reads out required programs and data by conducting read-out motion on the inserted DVD-ROM 10 under the control of the CPU 11.

The paint processing portion 17 conducts painting process for image data which is read out from DVD-ROM 10 and processed by the CPU 11. As the display of the image data is made by each [[flame]] frame, the [[flame]] frame

image data for each [[flame]] frame is generated at the paint processing portion. [[Flame]] Frame image data is constituted by ~~allegation~~ aggregation of the pixel data included in the image area of pixel number H for the horizontal direction and pixel number V for the vertical direction. The paint processing portion 17 performs display processing by generating 60 [[flame]] frame image data one by one per one second according to the NTSC system.

There are the first display mode and the second display mode as display processing of the game screen of this embodiment. As described [[latter]] later, switching operation to one display mode is conducted under the certain conditions by the control of the CPU 11. The first display mode is an arrangement where the pixel location is dislocated from each other by half-pixel size in the vertical direction between odd number ~~flames~~ frames and even number ~~flames~~ frames, and they correspond to different pictures respectively. Accordingly, the resolution can actually be doubled by the [[flame]] frame image data of the odd number [[flame]] frame and the even number [[flame]] frame. On the other hand, in the second display mode, the pixel location of the odd number [[flame]] frame is same as that of the even number [[flame]] frame, and the resolution equals half of that of the first display mode.

Here, there will be explained a structure of a [[flame]] frame image data used in the first display mode by showing FIG. 2. In FIG. 2, a pixel arrangement

on the monitor 19 corresponding to [[of]] the [[flame]] frame image data for the odd number [[flame]] frame and the even number [[flame]] frame is respectively shown. In both of them, pixels number V in vertical direction and pixels number H in horizontal direction, V x H of pixel data p in total, are arranged. It is apparent that their pixel location is dislocated by half size of a pixel each other in vertical direction as indicated with the dotted line by comparing the odd number [[flame]] frame with the even number [[flame]] frame. Accordingly, in the case where the odd number [[flame]] frame and the even number [[flame]] frame are displayed alternately, pixel numbers in the vertical direction are increased to 2H, resulting in the improvement of the resolution.

On the other hand, in the second display mode, the odd number [[flame]] frame and the even number [[flame]] frame are arranged at the same location with no difference in pixel arrangement of [[flame]] frame image data. Accordingly, the resolution of the image by the second display mode is actually half of that by the first display mode.

Then going back to FIG. 1, the [[flame]] frame buffer 18 stores 1 [[flame]] frame size of [[flame]] frame image data generated by paint processing portion 17. Accordingly, the paint processing portion has a capacity for storing the [[flame]] frame image data comprising at least V x H of pixel data. The [[flame]] frame image data stored in the [[flame]] frame buffer 18 is read out by 60 ~~flames~~

frames per one second from [[flame]] frame buffer 18 and is output to the monitor 19. As the monitor 19, a home-use television set referenced to the NTSC system can be used.

The sound processing portion 21 converts the sound data read out from the DVD-ROM 10 into analogue sound signal and outputs it to the speaker 22. Further, the sound processing portion 21 generates sound ~~effect~~ effects and musical sound required during the game and converts them into analogue signal and then outputs it to the speaker 22 in compliance with the command made by the CPU 11.

~~Then, there will be explained display~~ Display processing in the embodiment of the present invention will now be explained by referring to FIG. 3. FIG. 3 is a flow chart showing a display processing for displaying a game screen on the monitor 19. In this embodiment, switching operation to/from the above described first display mode or the second display mode is made corresponding to the scale of the processing load controlled by the CPU 11. Here, the processing controlled by the CPU 11 performs each processing unit one by one as a loop so as to be synchronized with one [[flame]] frame. For example, [[these]] each processing unit comprises a judgement routine of the content of the operation by the controller 15, a consideration routine of the character, display control routine, and various [[kind]] kinds of other processing.

Firstly, in step S1, a required time for a unit processing within one [[flame]] frame is detected. If the processing performed in each [[flame]] frame includes a plurality of unit processing, the time required for each unit processing may be detected. For example, the time required for each unit processing can be detected by providing a clock device controlled by the CPU 11. Next, in step S2, the cumulative processing time Ta required for each unit processing is calculated. The cumulative processing time Ta may be directly detected by means of the clock device.

Next, in step S3, the cumulative processing time Ta within one [[flame]] frame is compared with the predetermined reference value Tr. This reference value may be set as approximately the same as a time for one [[flame]] frame. With the comparison result in step S3, if it is judged to be Ta<Tr (step S3; YES), then the process proceeds to step S4. If it is not judged to be Ta<Tr (step S3; NO), then the process proceeds to step S5.

In step S4, it is judged whether the above described first display mode is currently being set in display processing. In step S5, it is judged whether the above described second display mode is currently being set in display processing. With the judgement result in step S4, if it is judged that the first display mode is currently set (step S4 ; YES), then the process proceeds to step S9. In a same manner, with the judgement result in step S5, if it is judged that the second

display mode is currently set (step S5 ; YES), then the process also proceeds to step S9. Namely, both cases correspond to the case where the current display mode is kept as it is.

On the other hand, with the judgement result in step S4, if it is judged that the first display mode is not set, but rather the second display mode is set (step S4 ; NO), then it is judged whether the situation of Ta<Tr is consecutively made in M ~~flames~~ frames in step S6. The purpose of this process is to wait for the stability of the status at a certain level even if the processing load is lightened in the setting process to the second display mode. In addition, the consecutive [[flame]] frame number M in step S6 may be ~~settled~~ set appropriately by considering the rapidness and the stability of switching.

If a continuous M ~~flames~~ frames of the condition Ta<Tr is made as a result of the judgement in step S6 (step S6 ; YES), the process proceeds to step S9 after switching to the first display mode in step S7. Namely, in this case, as it is judged that there is an enough margin in processing load, a priority is set on the picture quality and display processing with the [[flame]] frame image data in which pixel position of odd number ~~flames~~ frames is dislocated from that of even number ~~flames~~ frames as described above is performed hereafter. On the other hand, if the number of ~~flames~~ frames in which the condition Ta<Tr is made is

less than M as a result of judgement in S6 (step S6 ; NO), the process proceeds to step S9.

~~Besides~~ In addition, it is judged that not the second display mode, but the first display mode, is ~~settled~~ set as a result of step S5, (step S5 ; NO), the process proceeds to step S9 after switching to the second display mode in step S8.

Namely, in this case, as it is judged that there is not [[an]] enough of a margin in processing load, for lightening the processing load, the display processing with the [[flame]] frame image data in which the pixel positions of odd number ~~flames~~ frames and even number ~~flames~~ frames are arranged in the common position as described above is performed hereafter.

Next, in step S9, a paint processing for object [[flame]] frame is performed by the first display mode or the second display mode. Namely, the [[flame]] frame image data to be stored in [[flame]] frame buffer 18 is read out and output on the monitor 19 as a game picture of one [[flame]] frame size. Then, in step 10, it is judged weather the display processing of the game picture is finished. If it is judged that the processing is continued (step S10 ; NO), steps after S1 are repeated. If it is judged that the processing is finished (step S10 ; YES), the process in FIG. 3 is finalized.

As described above, in the process of FIG. 3, the switching from the first display mode to the second display mode or from the second display mode to the

first display mode is performed. If the whole processing scale expands and it becomes impossible to catch up the paint processing, then the second display mode which requires lighter load for paint processing is ~~settled~~ set. On the other hand, if the whole processing scale shrinks and there is an enough margin for paint processing, the first display mode which provides [[with]] a better picture quality is applied. Accordingly, the disorder of the picture displayed on the monitor 19 can be prevented beforehand and a high quality picture can be realized.

Although ~~the case where~~ the invention is applied by example to the game system in the above described embodiment, this invention is not limited to the embodiment. The invention also can be applied to other forms of systems with image display processing. ~~Besides~~ In addition, as a storage medium for storing game program which makes the invention function, the CD-ROM, the floppy disc, the hard disc, and various kind of storage medium can be used in addition to the DVD-ROM.

As described above, according to this invention, a high quality image display is realized without the disorder on the screen even if the processing load increases during the image displaying.

The entire disclosure of Japanese Patent Application NO 2000-130254 filed on April 28, 2000 including specification, claims, drawings and summary

are incorporated herein by reference in its entirety. While the invention has been described in connection with what is presently considered to be the most practical and preferred embodiment, it is to be understood that the invention is not to be limited to the disclosed embodiment, but on the contrary, is intended to cover various modifications and equivalent arrangements included within the spirit and scope of the appended claims.

ABSTRACT OF THE DISCLOSURE

~~It is an object of the present invention to enable to provide with a~~ An image display method [[which]] avoids disorder when displaying ~~displays~~ a high-quality picture ~~without making any disorder on the screen even,~~ when [[the]] processing load increases.

~~——~~A required time for each unit processing within one [[flame]] frame is detected during the image display processing, and a cumulative processing time Ta ~~which is a total of each unit processing time~~ is calculated. Then it is judged weather the situation Ta<Tr is [[made]] met for ~~the predetermined~~ a reference value Tr, and a first and second display mode is alternatively set depending on the judgement. ~~By the result of the above judgement, the~~ The first display mode, in which the pixel position of an odd number [[flame]] frame and an even number [[flame]] frame are differently arranged is set when the condition Ta<Tr is satisfied indicating that load is relatively light, and the second display mode in which the pixel position of an odd number [[flame]] frame and an even number [[flame]] frame are identically arranged, ~~are alternatively settled~~ is set when the condition Ta<Tr is not satisfied, indicating that the load is relatively heavy. Then, [[the]] paint processing ~~for the object flame~~ frame is performed. ~~The first display mode which has advantage in picture quality is settled if the processing load is light. The second display mode is settled if the processing load is heavy.~~

~~Accordingly, the disorder on the screen caused by the delay of processing is prevented and the high quality image display is realized.~~